

***In situ* characterization of EUV multilayer mirrors deposited by UHV magnetron sputtering**

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INTRODUCTION

Mirrors with a high reflectance at normal incidence in the extreme-ultraviolet (EUV) wavelength region are useful in a number of applications, including EUV lithography, astronomy and microscopy. To date, the best results were obtained with Mo/Si and Mo/Be multilayers with measured peak reflectances of ~67.5% and ~70.2% in the 13.0–13.5 nm and 11.1–11.8 nm wavelength regions, respectively.¹ However, a critical limitation to achieving the maximum theoretical peak reflectance is the oxidation and corrosion of the top layers, which both increase the absorption and degrade the phase coherence of the reflection from these layers.² Preliminary studies of the effect of surface oxidation on the reflectance of Mo/Si multilayers were performed.

EXPERIMENT

A unique deposition-reflectometer system, constructed at the National Research Council of Canada, was used for those experiments.³ This system was designed to deposit single or multilayer coatings and then to measure their reflectance *in situ* without exposure to ambient air. Two Mo/Si multilayers were fabricated and near normal incidence (5°) reflectances of 66.7% around 13.5 nm were measured for both samples, immediately after deposition (Fig. 1). This is comparable to the best reflectances reported to date and represent an achievement for the type of system we used for the deposition.

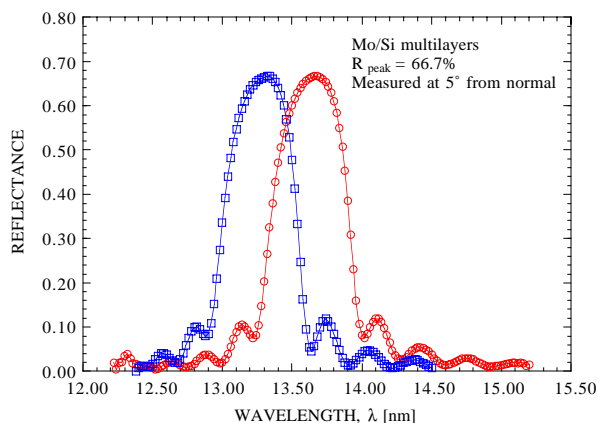


Fig. 1 Peak reflectances near 67% were measured for two Mo/Si multilayers around 13.5 nm at 5°.

Preliminary experiments where the reflectance of the samples is measured at regular intervals of exposure to air were performed. Surprisingly, the reflectance of both samples remained stable over the 48-hours period they were monitored. A rapid decrease of the reflectance with the oxidation of the top Si layer was expected. More extensive experiments are required to confirm and explain this result.

SUMMARY

Excellent Mo/Si multilayer mirrors were deposited and characterized with a new hybrid deposition-reflectometer system. Two samples with reflectances comparable to the best obtained to date were achieved and were monitored over a period of 48 hours. The results are still pre-

liminary and more extensive studies are required to understand the oxidation process of the Mo/Si multilayer surfaces.

These experiments were made on well-known and stable Mo/Si multilayer mirrors. Future work with this deposition-reflectometer system will involve more exotic material pairs where the unique capability of the system can be exploited. For example, Mo/Y and Mo/Sr multilayers, which are known to be much less stable in air, will soon be investigated.

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